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PACIS 2012 Proceedings

Pacific Asia Conference on Information Systems (PACIS)

7-15-2012

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TOWARDS COLLABORATION VIRTUALIZATION THEORY

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Abstract:

With widespread use of collaboration technology and increasing dispersion of teams due to globalization of companies, more and more collaboration activities are being conducted virtually. However, virtual collaboration seems to work well for some cases, but not for others. This phenomenon motivates research questions: What factors determine the suitability of collaboration virtualization, and how do those factors affect the design of effective collaboration systems? Our literature study yielded little theoretical work in this regard. As such, we believe that research on collaboration virtualization theory (CVT) is critically needed. To this end, we present our preliminary findings on the purpose and composition of collaboration virtualization theory based on the literature. Essentially, our CVT contains three categories of constructs: task, team, and technology characteristics. Our main objective in this short paper is to initiate a new theoretical perspective for research in the field of collaboration technology and management.

Keywords: Collaboration Virtualization Theory, Virtual Team, Collaboration Technology.

1. INTRODUCTION

Collaboration is broadly defined as a process that more than two people work together to achieve a common goal. Recent years have witnessed a trend of collaboration virtualization: geographically or temporally dispersed people collaborate with each other via collaboration technologies or other virtual means. Group-based collaboration and technologies to support a broad range of interaction have proliferated and are increasingly a central component in organizations (Smith and McKeen, 2011). Martins et al . (2004), in a review of the literature on virtual collaboration, conclude that "with rare exceptions all organizational teams are virtual to some extent."

The move towards collaboration virtualization is faster than ever before. However, some tasks are more successful with virtual collaboration while others are more successful with physical collaboration. For example, some virtual teams achieve improved performance through virtual collaboration with the support of advanced technologies (May and Carter, 2001). However, when facing great management challenges, physical collaboration is better than virtual collaboration (Kirkman et al., 2002). Similarly, when compared with physical group decision making, virtual group decision making could either be more or less effective (Denis et al., 2001). Although virtual collaboration is and will continue to be an important and necessary type of work arrangement, it is not appropriate for all circumstances (Nemiro, 2002). It is not clear what precisely the determinants of effective virtualization are. These observations lead to the following research questions: What factors of collaboration affect suitability of virtualization? And how do those factors affect the design of effective collaboration systems.

This paper addresses this question by proposing CVT. As a theory, it integrates and builds upon prior academic research to propose specific constructs, relationships among those constructs and propositions. The theory contains three categories (e.g. task, technology, and team) of constructs that determines the suitability of collaboration virtualization. Moreover, it discusses how multi-task degree is related to virtual collaboration management, a novel yet salient factor that has not received much research attention from virtual team scholars.

The main contribution of this research is to extend previous studies on virtual collaboration by providing new theoretical insights on the suitability of virtual collaboration. The result of our investigation will help collaboration managers better understand the requirements of virtual collaboration management in different contexts. The rest of this paper is organized as follows: The second section reviews the relevant literature. A conceptual model and propositions are then presented in the third section. Finally, the paper concludes with expected findings and implications of this study and future research directions.

2. LITERATURE REVIEW

Collaboration involves multiple individuals who combine their efforts to achieve mutually desired states or outcomes. Briggs et al. (2006) define collaboration as joint effort towards a group goal. There is no doubt that information and communications technologies are enabling different ways of working. Smith and McKeen(2011) point out that IT is one of the key components for successful collaboration. They further elaborate four fundamental building blocks of collaboration IT: communication, information access and management, security and risk, and technology integration. Literature has shown that information technology is a significant factor in facilitating the success of collaboration (Majchrzak et al.,2004).

IS literature suggests that collaboration efficiency is significantly affected by the media selected for collaboration. Selecting the right collaboration tool is essential for a high level of collaboration performance. Given the wide range of tool options from email to instant messenger, theories adopting this perspective try to establish a set of principles which would guide users to select the most appropriate tool for facilitating collaboration. Media richness theory (Daft and Lengel, 1986) and task-technology fit theory (Zigurs et al., 1999; Tan et al., 1999) state that the medium used for team communication should fit the type of information needed for the task. Also, media synchronicity

(Dennis and Valacich, 1999) establishes a connection between the task and the way the information is exchanged.

Process virtualization theory is designed to explain why some processes are more suitable to being conducted virtually than others. There are four constructs in process virtualization theory that describe process characteristics: sensory requirements, relationship requirements, synchronism requirements, and identification and control requirements. According to process virtualization theory, if a process requires more human sensory experience, social context, time control, and identity control, it will be less amendable for virtualization. Moderating effect of effects of representation, reach, and monitoring capability are also discussed in this theory.

Most existing theories (e.g. task-technology fit theory, media richness theory, and media synchronicity theory) can be used to explain the relationship between IT and collaboration performance. However, performance is not always the only concern for collaboration management. For example, when the output of a task is highly sensitive, physical collaboration is preferred even the performance of virtual collaboration is better (Hunsaker and Hunsaker, 2008). Few theories can explain whether a collaboration task is suitable to virtualization. Process virtualization theory can partially explain whether a process is suitable for virtualization. However, collaboration is a special type of process that includes communication, coordination and cooperation. Group, task and technology characteristics should be considered when making the decision of collaboration virtualization. Therefore, we need a new theory to explain the virtualizabilty of collaboration. This is an imperative due to the increasing pervasiveness of virtual collaboration team work in modern organizations today.

3. COLLABORATION VIRTUALIZATION THEORY

3.1 Definitions and Overall Conceptual Model

Collaboration is defined as a process where more than one individual work together to achieve a common goal**.** First, we define some terms that are important for CVT.

- *Virtual collaboration* is a collaboration process that participants interact "virtually" (via IT-enabled channels) to achieve a goal. Most researchers define it in terms of dispersion on various dimensions, at a minimum across time or space.
- *Physical collaboration* is a collaboration process that participants work face-to-face to achieve a goal.
- *Collaboration virtualizability* is the suitability for virtual collaboration.
- The transition from physical collaboration to virtual collaboration is defined as *collaboration virtualization.*

Using meeting as an example, team members can either have a virtual meeting through a web meeting system or have a physical meeting by gathering all team members in a conference room. Table 1 compares the differences between fully virtual collaboration and fully physical collaboration.

Fully Virtual Collaboration	Fully Physical Collaboration
Team members are all located in different locations.	Team members are all co-located.
Team members communicate through virtual means.	Team members communicate face-to-face
Team members may communicate asynchronously	Team members must communicate synchronously
Team members may devote part of their attention to collaboration	Team members devote all their attention to collaboration

Table 1. Difference between virtual and physical collaboration

Our literature review yielded surprisingly little in terms of a systematic, theoretical discussion of the factors of virtualizability of collaboration. In virtual collaboration, teams employ certain technologies to collaborate on a project. This implies that traditional collaboration research, conducted in physical environment, performing contrived tasks, will not be particularly applicable. We reviewed the virtual collaboration literature published in recent 15 years to develop three theoretical categories of the factors that may have important effects on collaboration virtualizability: team, task and technology characteristics (Smith and McKeen, 2011; Straub and Karahanna, 1998; Kirkman and Mathieu 2005; Kirkman et al., 2002). Then, we developed a model of the three categories of constructs that are likely to lead to lower or higher levels of virtualizability.

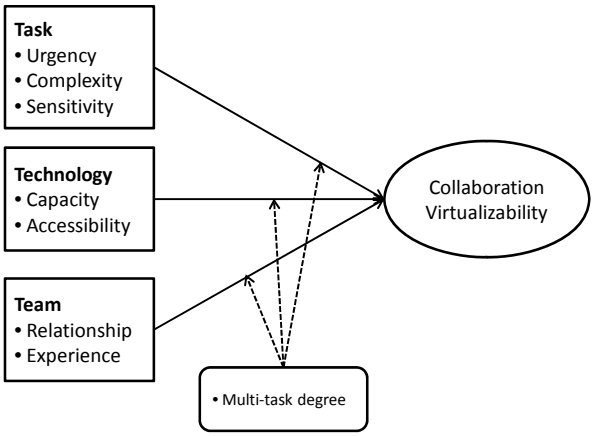

Figure 1. Conceptual Model of CVT

Every collaboration process is virtual to a certain degree (Griffith et al. 2003; Martins et al., 2004). Thus, the overall collaboration process is neither purely physical nor purely virtual, but a hybrid of the two extremes. The distinction between physical and virtual collaboration is more continuous than discrete. Most collaboration may contain both physical and virtual activities. CVT can be applied to each activities of the whole collaboration process. For example, a new product development project may have both face-to-face and remote meetings. The face-to-face meeting is considered as physical collaboration and other forms of remote meetings are virtual collaboration. The suitability of a virtual meeting is determined by task, technology and team of the meeting.

3.2 Task Characteristics

Not all tasks are equally suitable for virtual collaboration. The nature of collaboration tasks is important for collaboration management. For example, researchers have found that physical collaboration (face-to-face) are preferred for equivocal tasks (Daft and Lengel, 1986). Moreover, security and physical constraints of tasks also need to be considered when collaborating virtually (Hunsaker and Hunsaker, 2008). Based on the literature, we derive three characteristics of tasks as important indicators of collaboration virtualizability.

Task Urgency is defined as the degree of temporal constraints posted on the task. The logical reasoning behind this proposition is straightforward. For urgent tasks, collaboration needs to be done within a short time period. More urgent tasks incline people toward real-time, synchronous response communications. All things being equal, urgent tasks are predicted to be correlated with synchronous media such as face-to-face meetings and telephone (Straub and Karahanna, 1998). Previous researchers have also proven the fact that it takes longer for teams to collaborate via virtual means than it does face-to-face (Baltes et al., 2002). Physical collaboration participants can interact with one another with little delay because they are all located in the same place. By contrast, virtual collaboration participants are located away from one another, which may introduce delays into the collaboration. Thus, urgent tasks require more synchronous collaboration management. Based on process virtualization theory (Overby 2008), more synchronism requirements lead to lower virtualizability.

Proposition 1. The more urgent the task, the less virtualizable the collaboration is.

Complexity is a measure of the amount of mental and physical efforts needed for achieving the goal (Rana et al. 1997). It is related to three aspects: the structural certainty, the information processing requirement and interdependency. As teams perform more complex tasks, they are expected to be more likely to use synchronous communication media (Bell and Kozlowski 2002). Further, knowledge is not well-structured in complex tasks (Rana et al. 1997). As a result, it's hard to represent and transmit knowledge through virtual means for complex task collaboration. Complex tasks are likely to be better done with technologies of higher informational value and synchronous member interactions (Kirkman and Mathieu 2005). Also, complex tasks require more precise forms of coordinated effort because team members' roles become highly interdependent and the need for reciprocal communication is essential. For example, Straus and McGrath (1994) compared the performance of face-to-face groups on three tasks of different complexity to that of computer-mediated groups. They found that face-to-face groups did perform significantly better than computer-mediated groups on a more complex task. Research has shown that synchronous communication is superior to asynchronous communication for complex tasks that require a great deal of information sharing and collaborative decision making. Therefore, complex task requires support for highly synchronous communication and coordination and leads to low virtualizability.

Proposition 2. The more complex the task, the less virtualizable the collaboration is.

Sensitivity is defined as the need to protect task-related information from being disclosed to others who might have low or unknown trustworthiness or undesirable intentions. Due to many potential security risks in virtual teams and Internet-based technology, virtual collaboration is susceptible to unauthorized information leaking (Lee, 2009). Participants cannot physically inspect others to confirm their identity in the virtual environment. Security threats in virtual collaboration can be classified into social (e.g. phishing attacks and social engineering) and technical perspectives (e.g. worms and virus). The security of virtual environments and the integrity of virtual objects may also be targeted by malwares and bots that scan for weaknesses. Virtual collaboration relies much on information technology and social media and is vulnerable to both social and technical security threats (Hunsaker and Hunsaker, 2008). Therefore, sensitive tasks require more identity control, encryption and mentoring mechanism, thus are less virtualizable.

Proposition 3. The more sensitive the task, the less virtualizable the collaboration is.

3.3 Technology Characteristics

IT plays an important role in virtual teams (Smith and McKeen, 2011). Virtual teams use IT to communicate and coordinate. Whether IT can provide sufficient support for virtual collaboration is an important concern of collaboration management. So it is important to consider available IT support when collaborating virtually. We derived two technology characteristics that may affect collaboration virtualizability.

Capacity is related functional options, communication bandwidth and information richness that are provided by information technology. Advanced collaboration tools have encouraged organizations to assign tasks to groups that are distributed rather than co-located (Sengupta and Zhao, 1998). Smith and McKeen (2011) pointed out that IT is one of the key components for successful collaboration. Collaboration technologies usually can be classified into different levels based on their functionalities, richness and communication bandwidth. Collaboration is a reciprocal process that team members share knowledge with each other and achieve shared understanding. During the process, team members need to participate in different kinds of communication and coordination processes. As such, virtual collaboration cannot be carried out smoothly without the support of IT at all levels mentioned above. Thus more IT capacities will make it easier for virtual collaboration management.

Proposition 4. The more capacities information technology can provide, the more virtualizable the collaboration is.

Accessibility is defined as the degree of ease to access information technologies. Accessibility of a technology is influenced by infrastructural factors (power supply, hardware support, network

availability, etc.) or software service and support (software quality, stability, etc.). Accessibility to a collaboration technology is a fundamental requirement for technology usage. The difficulty in accessing the information system will hinder a potential user from using it (Kling & Elliott,1994). Further, better accessibility leads to more usage of an information system (Graham, 1995). In research of digital library systems, researchers found the positive effect of accessibility on perceived ease of use. Media accessibility will increase IT usage in virtual team (Park et al., 2009; Thong et al., 2002).

Proposition 5. The more accessibility information technology can provide, the more virtualizable the collaboration is.

3.4 Team Characteristics

IT function alone cannot make collaboration happen, even if it provides robust collaboration technologies. The nature of groups will also influence the success of virtual collaboration (Handy, 1995). For example, some groups are good at virtual collaboration while others tend to resist because of team convention or norms. We derived two team characteristics as predictors of collaboration virtualizability.

Team Relationship is defined as the degree to which team members are familiar with each other. Due to the absence of social cues in electronic media, developing interpersonal relations is very difficult in virtual collaboration (Yoo and Alavi, 2004). However, trust between team members has significant impact on the success of collaboration. According to O'Hara-Devereaux and Johansen (1994), "Trust is the glue of the global workspace, and technology doesn't do much to create relationship."Handy (1995) points out that, in virtual organizations, trust requires constant face-to-face interaction-the very activity the virtual collaboration tries to avoid or reduce. Further, familiarity among team member allows them to know each other's expertise and reduce knowledge barriers during virtual collaboration. Therefore, lack of relationship and trust reduces virtualizablity of collaboration (Aubert and Kelsey 2003).

Proposition 6. The stronger relationship among team members, the more virtualizable the collaboration is.

Team Experience is defined as the degree to which the team is familiar with task and technology. Experience with task will reduce uncertainty of tasks, increase self-efficacy and lead to better collaboration (Staples 1999; Littlepage 1997). Goodman et al.(1991) have shown that familiarity with the task is positively related to the level of group success. In addition, team experience with technology will let the team appropriate themselves with the technology and achieve better outcomes (Majchrzak et al., 2000).

Proposition 7. The more experience the team has, the more virtualizable the collaboration is.

3.5 Moderating Effect of Multi-task Degree

Multi-task degree is defined as the number of tasks assigned to team members at the same time. One of the main differences between physical and virtual collaboration is that members of virtual team do not belong to only one organization or team and cannot pay continuous attention to virtual collaboration. In virtual collaboration, participants usually work on multiple tasks at the same time and they devote a portion of their attention to each task. As such, it is appropriate to use an attention-based view to analyze virtual collaboration (Ocasio, 1997). A major challenge for virtual collaboration managers is their inability to physically observe their employees' participation and manage their attention. As such, attention management is critical for successful outcomes of virtual collaboration (Davenport, 2001). Collaboration carried out under high degree of multi-task will require many coordination and communication efforts among team members. When degree of multitasking is high, collaboration technologies should provide additional functionalities for attention management. Further, when tasks are complicated, the management of collaboration could be even

more complex. The detailed moderating effects of multi-task degree need more investigation in our future work. Therefore, we have the following proposition:

Proposition 8. The degree of multi-task moderates the relationship between task, team and technology characteristics and collaboration virtualization.

4. DISCUSSIONS AND CONCLUSIONS

In this paper, we proposed CVT to explain the suitability of virtual collaboration in organizations. CVT extends existing theoretical work on collaboration management by trying to incorporate three categories of constructs to predict collaboration virtualizability. Moreover, multi-task degree is defined as a unique concept in virtual collaboration and its relationship with virtual collaboration is discussed. The theory will also guide practitioners to consider how IT might help satisfy the requirements of virtual collaboration management. In this way, CVT can be used as a measure to manage collaboration tasks.

Our further work mainly focuses on testing the validity of the CVT and on how CVT factors affect the design of collaboration technology and management. Plans are in place for conducting case studies with both virtual and physical collaboration teams to gain deeper insights into collaboration virtualization. It is hoped that data collected from the case studies will help validate the conceptual framework, and provide an opportunity to generate testable hypotheses for future quantitative work.

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